



M
A
R
S
H
A
L
L
I
S
L
A
N
D
S

HAZARD MITIGATION PLAN

UPDATE
Consider FEMA

1997
Revised Edition

Produced by the National Disaster Management Committee
with the assistance of the South Pacific Disaster Reduction Programme (SPDRP)



TABLE OF CONTENTS

SECTION 1: INTRODUCTION

- A: PURPOSE
- B: SCOPE
- C: OVERVIEW OF AUTHORITIES
 - 1. FEMA
 - 2. RMI
- D: DESIGNATION OF LEAD AGENCY
- E: OBJECTIVES

SECTION 2: HAZARD ANALYSIS

- A: VULNERABILITIES
- B: NATURAL HAZARDS
 - 1. Typhoons
 - 2. Floods
 - 3. Earthquakes
 - 4. High Surf/Tsunamis
 - 5. Volcanoes
 - 6. Drought
- C: MANMADE HAZARDS
 - 1. Fire
 - 2. Marine Oil Spill
 - 3. Water Supply Contamination
 - 4. Hazardous Materials
 - 5. Epidemic Disease
 - 6. Commercial Transport Accidents

SECTION 3: EXISTING MITIGATION RELATED PROGRAMS/AUTHORITIES

- A: RMI MITIGATION RELATED PROGRAMS
 - 1. Conventions and Treaties
 - 2. Legislation
- B: THE RMI GOVERNMENT STRUCTURE, COMMISSIONS, COUNCILS AND AUTHORITIES
 - 1. Emergency Management Cabinet
 - 2. Ministry of Foreign Affairs
 - 3. Ministry of Finance
 - 4. Ministry of Education
 - 5. Ministry of Health
 - 6. Ministry of Resources and Development
 - 7. Ministry of Public Works
 - 8. Ministry of Transportation and Communication
 - 9. Ministry of Social Services
 - 10. Ministry of Internal and Outer Island Affairs
 - 11. Department of Public Safety
 - 12. Other
- C: FEDERAL PROJECTS/PROGRAMS
 - 1. US Army Corps of Engineers
 - 2. US Small Business Administration

SECTION 4: MITIGATION OPPORTUNITIES

- A: HAZARD MITIGATION OPPORTUNITIES
- B: SUMMARY AND CONCLUSIONS

SECTION 5: HAZARD MITIGATION INITIATIVES

- A: INITIATIVES - GENERAL STATEMENT
 - Category 1 : Existing Vulnerable Facilities
 - Category 2 : New Facilities
 - Category 3 : Vegetation Management and Agriculture
 - Category 4 : Coastal Management Protection
 - Category 5 : Environmental Management
 - Category 6 : Education and Training

SECTION 6: PLAN MAINTENANCE AND IMPLEMENTATION

- A: MAINTENANCE
- B: IMPLEMENTATION
- C: MONITORING
- D: EVALUATION

APPENDICES

- A: DEFINITIONS
- B: RECOMMENDATIONS
 - TROPICAL STORM ZELDA
 - TROPICAL STORM AXEL
 - TROPICAL STORM GAY
 - HIGH SURF EVALUATION (June 9 and 10, 1994)

SECTION 1: INTRODUCTION

A: PURPOSE

This Hazard Mitigation Plan has been prepared by the RMI Secretary of Public Works in concert with the Disaster Committee, Office of the Chief Secretary in compliance with and to fulfil the provisions of Section 409 of the Stafford Act. Section 409 requires governments to develop (through this Plan) and maintain a systematic program to identify hazards, monitor changes in vulnerability, develop and implement measures to reduce or eliminate these vulnerabilities.

This Plan analyzes the risk from hazards, reviews existing laws, programs and regulations, and proposes appropriate hazard mitigation measures and actions necessary for the implementation of these measures and actions to reduce these vulnerabilities.

The focus of this plan will be on vulnerabilities to tropical storms and typhoons as these reflect the most catastrophic threat to the islands. Major emphasis will be placed on recommendations from the Hazard Mitigation Survey Team Reports from the most recent tropical storms, Axel and Zelda (see Appendix B), to affect the islands. To a lesser extent this plan will consider other natural or man-made/technological hazards which affect or may affect RMI.

The final and most important element in the Section 409 process is to coordinate and monitor the implementation of the RMI Hazard Mitigation Plan. While numerous potential and real problems and solutions can be identified, the sheer volume would make their combined implementation impossible. For that reason, this report focuses on the common and recurring issues that face the Republic of the Marshall Islands each year.

B. SCOPE

This Plan contains six sections including this introduction. Section 2 provides an overview of the hazards experienced in the Republic of the Marshall Islands. Section 3 briefly explains the RMI government organisation, agency responsibilities related to hazard mitigation, and inter-agency relationships. Section 4 identifies hazard mitigation opportunities. Section 5 outlines and prioritizes hazard mitigation initiatives. Section 6 discusses procedures for plan maintenance and implementation.

C. OVERVIEW OF AUTHORITIES

1. Federal Emergency Management Agency

As a result of the Stafford Act, if the severity of an emergency is such that it exceeds the response capabilities of the Republic, its President can request the President of the United States to issue a major disaster declaration. If declared, FEMA then co-ordinates all disaster relief assistance provided by Federal agencies and may co-ordinate the relief assistance of private organizations and State and local governments.

As a condition of receiving Federal disaster assistance, Section 409 of the Act requires that, at a minimum disaster recovery activities, including repairs, restoration, or replacement be accomplished in accordance with applicable codes, specifications and standard. Section 409 also requires the Republic to review and update its existing Hazard Mitigation Plan (this plan) to reflect the

current disaster, the lessons learned and the actions that must be taken to reduce the potential loss of life and property from future tropical storms, typhoons, or other threats.

2. Republic of the Marshall Islands

Under Section 409, FEMA encourages RMI and local governments to develop and maintain a program to implement measures for reducing vulnerability to hazards such as tropical storms and typhoons. Disaster declarations become opportunities to review and update existing hazard mitigation plans, or to develop new plans. The recovery period following a disaster becomes an opportune time to implement mitigation measures. However, implementation should be an ongoing, year round effort.

This Plan has been developed by the Secretary of Public Works with participation, from the Disaster Committee in compliance with the Stafford Act, RMI's Emergency Assistance Act and the Disaster Assistance Act of 1987. This Plan has been developed under the general authority of the Office of the Chief Secretary.

D. DESIGNATION OF LEAD AGENCY

For effective overall implementation of this Plan and evaluation of results, the President has designated the following lead agency:

Office of the Chief Secretary
National Disaster Management Committee
P O Box 15
Majuro, Marshall Islands 96960
011-692-625-5181

This agency is under the general supervision of the Office of the President.

E. OBJECTIVES

The primary goal of all mitigation is to protect human life, to minimize long and short-term damage to property and the environment and, ultimately, to reduce the need for future assistance from outside sources.

The specific objectives of this Plan include:

1. Identification, recommendation and implementation of appropriate cost effective mitigation initiatives that will reduce future disaster losses from tropical storms, typhoon, drought, flooding, high waves, fire et al;
2. Reduce vulnerability to hazards and associated damages through comprehensive planning, a review of existing land use regulations, building codes/construction standards, communications/utility networks and existing hazard mitigation legislation or programs.

SECTION 2: HAZARD ANALYSIS

A. VULNERABILITIES

The islands and atolls within the Republic of the Marshall Islands are subject at all times to natural disasters such as high waves, tsunamis, fires, flooding, drought et al. The single most predictable and frequent threat to RMI is from the effects of tropical storms and typhoons, the primary subject of this report.

Other potential hazards are man-made events which include: structural fires, oil spills, hazardous materials incidents, water contamination, toxic or chemical accidents, commercial transportation accidents, epidemic sickness and radiological exposure.

Man-made disasters of major proportion, have not occurred during the past 20 years with the exception of a major fire of unknown origin on February 24, 1987 that destroyed the medical supply building. As a result of this fire, Majuro Atoll was declared a major disaster area on April 27, 1987 (FEMA-791-Dr). In light of this rather isolated event, the growing population, over crowding, lack of building control, construction standards, zoning laws, floodplain management on RMI increases the vulnerability and risk. This greatly increases the potential for catastrophic results should disaster strike.

B. NATURAL HAZARDS

1. Tropical Storms and Typhoons

The greatest chance of disaster in RMI and throughout much of the Pacific Area comes from tropical storms and typhoons. Most commonly striking from August through December, tropical storms have maximum sustained winds of 38 to 73 mph and typhoons have maximum sustained winds ranging from 75 mph up to 200 mph or greater. While the occurrence of extremely high velocity typhoons is rare, lower velocity systems can bring destructive winds, heavy rains, flooding, and severe storm surge. RMI borders the typhoon belt, but the country averages about one major tropical storm every five years and typhoons average about one every 75 years.

The historical record in the Marshalls for typhoon disasters is largely incomplete. Typhoons are shown to have occurred in the Marshall Islands in 1890, 1905, 1918, 1951, 1957, 1988 and most recently Tropical Storm Zelda (November 28, 1991). Typhoon Axel (January 6, 1992) and Typhoon Gay (November, 1992).

The hazards resulting from the most recent cyclones were related to local flooding due to heavy rains, high winds, salt spray, and extreme wave action that can devastate the low lying atolls.

The major effects of the hazards in terms of damage include loss of subsistence food crops from high winds and salt spray (associated vitamin A deficiency), contamination of potable water supply (associated diarrheal disease and conjunctivitis due to poor water conditions), and loss of residential structures. In addition, routine damages include debris and impacts to roads, water catchment systems, utility distribution system and other infrastructure.

2. Floods

Flooding is a problem generally affiliated with tropical storms or typhoons. The situation is compounded by the fact that the Marshall Islands make up a series of low lying atolls and islands.

3. Earthquakes

Earthquakes are extremely rare for the Republic, as a result the threat is perceived to be non-existent.

4. High Surf/Tsunamis

The last reported incidence of high surf occurred on June 9 and 10, 1994 where high energy storm conditions in the southern hemisphere created the source for wave trains to emanate from the center of a storm. The wave trains that caused the high surf at Majuro were propagated by a high, narrow band of winds compounded by high tides affecting the atoll at the same time. Major damage included the landfill (constructed on the ocean side of the atoll), the airport runway protective seawall, sand and rock debris, and 50% incapacitation to the airport water catchment system.

The incidence of Pacific-wide tsunamis has little affect on the Marshall Islands due to the fact that the atolls are so small and there is very little relief from the ocean floor. Since there are no significant steep sides for the seismic sea waves to run up - it is easier for the energy to move around the object. A comparison of tsunami height differences between atolls and other significant islands might be the March 9, 1957, 8 to 8.5 earthquake in the Aleutian Islands that caused a 3.6 meter tsunami in Kahului, Maui and a 4.2 meter tsunami in Hilo. The effects were a minimal 3 meters for Kwajalein and Enewetok. Of all the tsunamis researched in the last century, no tsunami has registered over 4 meters (May 22, 1960 - Chile 8.25 to 8.85 Earthquake) in RMI.

page 4.

Marie to check units

should be 30 cm (0.3 m)

Check last sentence and correct update with 2025

5. Volcanoes

Although the RMI atolls were originally formed from volcanoes, they have long since become extinct and have subsided, leaving coral atoll formations as remnants of their past activities.

6. Drought

The northern Marshalls are dry, averaging about 20 inches of rain in any given year. In the southern islands and atolls rainfall increases with some islands experiencing up to 160 inches per year. The water system for the Marshalls is primarily catchment, and these systems are very vulnerable to tropical storms and typhoons, Following a major typhoon, water can be a valuable commodity. Even though drought conditions don't exist prior to a typhoon replacement of stored water eliminated by a typhoon or tropical storm can take some time. Reference to the El Nino is as yet rather inconclusive therefore its presumed effects will not be addressed here.

C. MAN-MADE HAZARDS

In addition to natural hazards, other potential hazards are man-made and include the following :

1. Fire

Fire can be a serious problem for the over populated centers of Majuro and Ebeye. The last fire disaster occurred in Majuro on February 24, 1987, where the REPMAR government experienced a major fire of unknown origin which totally destroyed its medical supply building. The building served as the central depository for medical supplies and equipment awaiting disbursement of the numerous dispensaries in the outer islands of the nation. The building was wood frame with corrugated metal siding and a concrete foundation. Nothing was salvageable from the devastating fire. In light of this disaster, it should be noted that Ebeye, an area that has the dubious distinction of being the most densely populated area on earth, has construction methods that include thin-walled plywood structures that are placed within two feet of each other. With normal to moderate trade winds blowing at most times during the year, a fire could quickly engulf a major portion of the Ebeye urban area, thereby threatening an entire community. Fires could have a major catastrophic impact here.

2. Marine Oil Spill

An increase in development and tourism over time also increases marine traffic. A marine oil spill resulting from an accidental mishap could have irrevocable effects on the environment and marine industries. There is only one major port which is located in Majuro, and this may limit the geographic area of a major marine oil spill but does not minimize the potential impact.

3. Water Supply Contamination

RMI has no rivers or perennial streams. Rainfall is the main source of fresh water, and is generally captured through individual catchment systems. Other water systems include a large catchment system associated with the airport at Majuro and the Laura water Lens on Majuro Atoll which provides a subterranean source of water. The Lens is presently monitored by the Marshall Water and Sewer company and has a life of unlimited years if its use is regulated. The potential risk to the Laura Lens comes from development of the property above it. The pressure to develop there is very great since it is the largest land area on Majuro and has great natural beauty. The resultant hazards to the lens come from the disposal of sewerage effluent, pesticide use, livestock waste, accidental spillage of chemicals/oils etc.

4. Hazardous Materials

The release of hazardous materials could be caused by dramatic natural conditions, but normally the release is the result of improper handling, discharges by vessels, inappropriate storage, containerization or transport. The potential for massive loss of life or damage to the environment is incalculable. Hazardous materials that may affect RMI include petrochemicals.

Local sanitation is also a major problem and can be considered as hazardous materials when disposal is inappropriate. The shoreline of major populated areas, primarily Majuro and Ebeye is littered with trash. The bacteria

count in lagoons adjacent to populations centers is many thousand times higher than that deemed safe. Raw sewage flows directly into the lagoon at Ebeye and into the ocean at Majuro.

5. Epidemic Disease

Chronic overpopulation may be the forerunner to epidemic disease. The first case of AIDs to be reported in the Marshalls was January, 1993. As in any country, this has the potential to set a very frightening precedent. Prevalent epidemic diseases that are known to RMI are hepatitis and conjunctivitis.

In addition, unsanitary conditions can quickly arise in the aftermath of a typhoon if the numerous water, salt water and sewage pumping stations are rendered inoperable or during extended water rationing. Crowded conditions and the warm humid climate can easily and quickly contribute to the spread of epidemic diseases.

6. Commercial Transport Accidents

RMI is home to twenty four airports. Other than Majuro, Kwajelein and Roi-Namur airports, the airfields are short, non-sealed and are subject to extensive damage during a tropical storm, typhoon or high surf. Increased air service resulting from rapid growth in tourism and population produce a greater likelihood of and vulnerability to, airplane crashes in RMI. This compounded by the lack of trained responders and maintained equipment for response to such an event can create a catastrophic event in terms of potential lives lost.

SECTION 3: EXISTING MITIGATION RELATED PROGRAMS/AUTHORITIES

A. RMI EXISTING MITIGATION RELATED PROGRAMS

The following legislation, regulations, regulating bodies and agencies have, to varying degrees, activities, programs and/or policies related to hazard mitigation in the Republic of the Marshall Islands.

1. Conventions and Treaties

Compact of Free Association

The Compact, which took effect in 1986, defines the relationship between the United States and the Republic of the Marshall Islands following the termination of the United States Trusteeship. Under the Compact, the RMI is a sovereign nation responsible for its own domestic and foreign affairs, while the U.S. is given responsibility for external military defense and security matters. The US agreed to provide annual financial grants to the RMI for certain stated purposes during the fifteen year period of the agreement, and established its right to lease certain islands of the Kwajalein Atoll for the use of the US Army. Under the Compact various regulations and controls which were in force before the Compact, such as the US National Environmental Policy Act, remain in effect for continued US activities in the RMI.

South Pacific Regional Environment Program Convention

The Convention's goals are to prevent, reduce and control pollution resulting from vessels, land-based sources, sea-bed activities, discharges into the air, disposal of toxic and non-toxic wastes testing of nuclear devices, and mining.

2. Legislation

P.L. 1987-8 "Planning and Zoning Act of 1987"

The Act provides for planning and zoning process in the RMI, including empowering local government to establish a planning commission and planning office, approve local ordinances, establish zoning categories, and require building permits. The Act requires local government to create zones "...to secure safety from fire and other hazards". If local government fails to appoint a planning commission or make ordinances, the Act provides for the RMI Chief Planner "... to perform all or any of these functions and duties conferred on the Planning Commission or the local government Council under this Act."

P.L. 1987-20 "Disaster Assistance Act of 1987"

The Act outlines the responsibilities and powers of the RMI government regarding disaster prevention, response, recovery, and hazard mitigation. The Act establishes a Disaster Committee comprised of Ministry of Secretaries and is under the direction of the Chief Secretary who serves as the Disaster Co-ordinator. The Committee is responsible for assisting the Cabinet in responding to disasters, as well as establishing and maintaining a

Disaster Plan which includes hazard mitigation measures. The Act empowers the Disaster Committee to recommend to the Cabinet changes in existing building standards and land use controls to include hazard reduction measures.

P.L. 1984-31 "National Environmental Protection Act of 1984"

The Act establishes the Environmental Protection Authority, the purpose of which is "... to preserve and improve the quality of the environment..." and create "... conditions under which mankind and nature can coexist in productive harmony...". The Act establishes an Environmental Advisory Council comprised of senior officers of RMI's ministries and representatives from both private industry and the general public. The Council's purpose is to advise the Environmental Protection Authority.

P.L. 1983-16 "Housing Act of 1983"

The Act establishes the Marshall Islands Authority for purposes of establishing a housing program for RMI citizens, making or guaranteeing housing loans and determining where there exists "... danger from wave action or other natural disaster..." Among the powers of the authority is the ability to "... insure or provide for the insurance of, any property, project or operation against all or any risks and hazards..."

P.L. "Public Lands and Resources Act"

The Act defines "public lands" as those acquired by the RMI government for public purposes as well as land formerly owned by the Japanese government. All marine areas below the high watermark belong to the government, however, certain exceptions exist including the customary right to on-shore building construction. As of this writing the law has not yet been tested in the courts. In addition, it is RMI government policy to return public land, whenever possible, to its original customary owners. Land needed by government for its infrastructure requirements is mostly leased from private landowners.

P.L. 1987-8 "Land Acquisition Act of 1986"

The Act makes provisions for government acquisition of lands for public use with just compensation for the land. This Act allowing for "eminent domain" has rarely been invoked. Its use however is expected to increase commensurate with the growing need for public service uses of land.

P.L. 1988-13 "Coast Conservation Act of 1988"

The Act provides for a survey of the coastal zone and preparation of a coastal zone management plan to regulate and control development in the coastal zone.

P.L. "Public Health, Safety and Welfare Act"

This Act establishes a health services sector comprised of three sections: Public Health, Sanitation and Mental Illnesses. The Sanitation section regulates toilets and latrines, accumulations of rubbish, and food service establishments.

P.L. "Historic Preservation Act of 1991"

The purpose of the Act is to protect RMI’s historical heritage from destruction due to development projects. The Act establishes a Historic Preservation Office and an Advisory Council for Historic Preservation. Draft regulations pursuant to the Act have been proposed. These regulations would require developers to give 30 day advance notice before beginning construction during which time the RMI Historic Preservation Officer evaluates the site. If it is determined that the site is archaeologically significant, determination is then made whether to excavate the site before construction can begin or to relocate the development altogether.

P.L. 1988 Marshall Islands Marine Resources Authority Act

This Act co-ordinates and regulates the exploration, exploitation, and management of biological and physical resources. It includes prohibiting the use of fishing techniques which significantly damage the reef such as dynamiting or chemicals.

B. THE RMI GOVERNMENT STRUCTURE, COMMISSIONS, COUNCILS AND AUTHORITIES

In 1979 the government of the Republic of the Marshall Islands was officially established after 32 years as a US Trust Territory. The RMI entered into a Compact of Free Association with the United States for an initial period of 15 years, renewable thereafter. Under the agreement, the Republic is responsible for operating under its own constitution and conducting its own foreign and domestic affairs. The United States is responsible for defense, security and financial assistance to the Republic. The government is modelled after the British Parliamentary system with all legislative power vested in the 33-member Parliament elected from 24 districts. The Parliament elects a President from within every four years. The President serves as Head of the Cabinet as well as Head of State.

National Disaster Management Committee

The National Disaster Management Committee (NDMC), comprised of Ministry Secretaries, is under the direction of the Chief Secretary who serves as the Disaster Co-ordinator. The Committee is responsible for assisting the Cabinet in responding to disasters, as well as establishing and maintaining a Disaster Plan which includes hazard mitigation measures. The Disaster Committee is empowered to recommend to the Cabinet changes to existing buildings standards and land use controls for hazard reduction as well as providing advice to the Cabinet on other measures necessary for mitigating the effects of any disaster.

The NDMC encompasses the heads of those departments having an active role in disaster preparedness and response. The members of the committee have been delegated responsibility for co-ordinating and directing all counter-disaster activities on behalf of the RMI government. The committee is headed by the Chief Secretary and the members organisation name and responsibilities are as follow (1 - 11) ;

- Preparedness
- Response

1. Disaster Management, Cabinet

The Cabinet is responsible for :

- Setting the storm condition
- Informing the public
- Activating/deactivating the Disaster Committee
- Examine Options
- Issue Directions
- Order cessation of normal government business
- Order all vehicles off roads that are not involved in disaster tasks
- Declare disaster areas as appropriate and order damage assessment
- Authorize 'All Clear' announcement
- Authorize resumption of normal governmental activities

2. Ministry of Foreign Affairs

Responsibility lies with :

- Alerting heads of foreign missions

3. Ministry of Finance

The Secretary of Finance is accountable for :

- Preparation to accept and process departmental activities on disaster expenditure
- Preparation to implement the necessary accounting procedures for FEMA assistance
- Maintains detailed records of disaster expenditures employing the same procedures as are required for FEMA assistance

4. Ministry of Education

Responsibilities encompass the following :

- Close some public schools in outer areas in accordance with departmental SOP
- Open other schools which are capable of sheltering people
- Open schools upon 'All Clear' announcement

5. Ministry of Health Services

The Ministry of Health is responsible for the maintenance of 69 buildings including two hospitals (Majuro and Ebeye) and 57 dispensaries scattered among the islands and atolls.

The Secretary of Health is responsible for the following:

- Medical supply and equipment inventory is slated for possible use
- Alerts hospitals, dispensaries and mobile first aid teams
- Dispatches medical personnel with kits to each designated shelter
- Provides emergency medical care
- Establishes/reviews priorities for hospital facilities and supplies
- Undertakes protective measures for disease control
- Responsible for the identification, restoration and disposition of the

dead
Evacuates hospital patients as necessary

6. *Ministry of Resources and Development*

The Ministry of Resources and Development includes the Division of Agriculture which is responsible for the following :

- Co-ordinating agricultural development.
- Providing manpower and equipment support to Public Works.
- Co-ordinating and conducting complete damage assessment for disaster affected areas in accordance with departmental SOP and in conjunction with the Secretary of Public Works.

7. *Ministry of Public Works*

The Ministry of Public Works is divided into two major operations; the Central Government Maintenance Agency (CGMA) and the Department of Public Works. CGMA is responsible for maintenance of most of the vehicles and heavy equipment belonging to RMI. Public Works is responsible for maintenance activities, including: buildings, roads, landfill, landing craft operations.

The Secretary of Public Works is responsible for :

- Readiness of public shelters.
- Security of public facilities, including tie-down of loose materials.
- Ensures all government vehicles are secured.
- Ensures all disaster response assets are on alert and ready status.
- Inspects all public facilities and in conjunction with Marshall Energy Company, Majuro Water and Sewer Company and National Telecommunication Authority ensures emergency power, water and telephone systems are operational.
- Places all available transportation on standby.
- Conducts debris clearance, including removal of debris from private land when this is in the public interest.
- Conducts protective measures to minimize the effects of disaster., e.g. flood control protection against wave action.
- Provides supporting services to contractors assigned to improve public assistance programs; acts as contracts project manager.
- Inspects, repairs and reopens essential services in conjunction with EPA and MWSC including decontamination of water resources if required.
- Provides in conjunction with MWSC water to disaster area victims, as required.

8. *Ministry of Transportation and Communication*

Responsibilities encompass :

- Inspection and security of all buildings in communication area.
- Changes rosters to ensure operations and maintenance personnel can sustain 24 hour operations.
- Checks all government communications equipment and plants are secured.
- Inspects/tests emergency generator for operation ability.
- Checks all internal and international radio/telephone circuits.
- Ensures security of all government sea and air crafts are secured.

Places designated disaster response craft on standby.

9. Ministry of Social Services

Responsible for:

- Inventories of food stockpiles.
- Alerts social welfare teams.
- Arrangements for emergency food distribution.
- Co-ordinates mass feeding as necessary.
- Co-ordinates emergency shelter as required.

10. Ministry of Internal and Outer Island Affairs

The Secretary is responsible for:

- Public Information Activities including "Condition Announcements".
- Alert Radio Station V7AB for 24 hour operation.
- Alerts outer islands.
- Releases radio station (V7AB) to normal schedule of operation on direction from Disaster Committee.
- Co-ordinates with Public Works disaster relief efforts for outer islands.

11. Department of Public Safety and MALGOV Police Department

The Police Commissioner is responsible for :

- Review of evacuation plans and preparation for implementation.
- Deployment of designated personnel with radios to assigned shelters.
- Maintains contact with and provides messenger service to the Committee.
- Alerts Search and Rescue Teams.
- Provides protection as required.
- Assists in evacuation operations.
- Maintains law, order and traffic control.
- Provides prisoner labor to Public Works.
- Assists Public Works in damage assessment.

Information cited above for Section 3.A1 through A11 has been adopted from the Marshall Islands National Disaster Management Plan.

12. Other

Marshall Islands Development Authority (MIDA) - investigate, study, develop and implement social and economic development programs and projects, alone or in conjunction with other governmental, private organisations, or agencies, for the betterment of the economic and social conditions of the inhabitants of the Republic. Within MIDA's authority is the ability to acquire property for development, conservation or rehabilitation purposes.

Marshall Islands Development Bank - promote the development and expansion of the economy of the Marshall Islands in order to improve the standard of living of the people by adopting strategies that will develop and mobilize the human, natural, capital, technical, entrepreneurial and other resources of the country. The Bank's activities are designed to strengthen the nation's economic base, increase employment and production, promote exports, and reduce the country's dependence on imports and foreign aid.

Majuro Atoll Local Government - With a population of over 30,000, Majuro has the largest local government in the Republic. As Majuro is also the site for the capital of RMI, it is sometimes difficult to distinguish local from national operation and maintenance functions.

Office of Planning and Statistics - Established in 1980, the office is divided into three divisions: Planning, Statistics and Plan Implementation. The office was responsible for accomplishing the passage of the Planning and Zoning Act of 1987.

Marshall Energy Company - an autonomous government corporation, is responsible for the generation and distribution of electric power on the island of Majuro.

Majuro Water and Sewer Company - an autonomous government corporation responsible for water and sewer services on the island of Majuro.

National Telecommunications Authority - an autonomous government corporation responsible for RMI's telecommunications services.

Environmental Protection Authority - legislatively linked to the Ministry of Health Services is responsible for public environmental education, laboratory analyses, pollution control, nature preservation and regularity oversight of solid wastes, earthmoving, water quality, toilet facilities and pesticides activities.

Environmental Advisory Council - purpose is to advise the Environmental Protection Authority. The Council is comprised of senior officers of RMI's ministries and representatives from both private industry and the general public.

Rural Sanitation Project - was developed to improve rural sanitation standards by distributing water catchment systems and water-seal toilets to outer atoll households. The project is funded by USEPA and is currently administered by MIDA.

Historical Preservation Office - responsible for identification and recording of cultural and historic properties, issuance of denial permits related to land development, conducting surveys and formulating preservation plans, and developing a list of traditional objects prohibited from export. The office is placed within the Ministry of Interior and Outer Island Affairs.

Advisory Council for Historic Preservation - advise the Historic Preservation Office. The Council is comprised of senior officers of RMI's ministries, the Historic Preservation Officer, and the Chairman of the Council of Iroij.

C. FEDERAL PROJECTS/PROGRAMS

1. US Army Corps of Engineers

Provides emergency/disaster assistance under Public Law 84-99, Flood and Coastal Storm Emergencies. Under this law the Chief of Engineers, acting for the Secretary of the Army, is authorized to undertake activities including advance measures, emergency operations (Flood Response and Post Flood Response), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works threatened or damaged by coastal storm, and provisions of emergency water duet to drought or contaminated source.

2. US Small Business Administration

Provides financial assistance to disaster victims through long-term, low-interest loans (\$500,000 maximum) to repair/replace damaged businesses to their pre-disaster condition. Mitigation actions (tie downs, connecting roofs to structures, elevating units to the 100 year base flood elevation) are eligible items for SBA loans.

SECTION 4: MITIGATION OPPORTUNITIES

A. HAZARD MITIGATION OPPORTUNITIES

“Mitigation Activities. The RMI is a country of limited resources, and unfortunately, little preparation has been done to mitigate potential damage from a man-made or natural disaster. Little has been done to educate the general public on potential disasters, types of warnings, preparedness and proper actions to take to protect themselves. Likewise, the construction codes used in the RMI routinely permit the building of homes that simply will not stand up to tropical storms. Additionally, these homes with their 2 x 3 wall studs and plywood walls, are basically little more than death traps in the event of fires. The use of brick, block or precast concrete walls should be strongly encouraged for both wind and fire protection.”¹

In order for the Marshalls to become truly independent once more, it must concentrate on self-reliance and personal responsibility to eliminate the perpetual dependency on the United States for disaster assistance and other forms of foreign aid. In this effort, mitigation plays a very important role, to minimize the impact of natural events on the potential victims, private property and public infrastructure.

RMI needs to provide a strong commitment to reducing the danger of natural and man-made hazards, particularly due to the frequency and destructive potential of typhoons and other events in the Pacific Region. The primary responsibility for implementation of mitigation activities rests with the RMI government. To reduce hazards, programs must be developed that regulate primary and secondary hazards through disaster planning activities.

It should be noted that RMI has several current government programs underway that fall under the guise of mitigation. These include, but may not be limited to: a) Agricultural nurseries and seed stock, b) Coastal Management Protection Plan by RMI EPA, c) Institution of electrical inspections by the MEC, and d) Renewed interest in the monitoring of the Laura Freshwater Lens by Public Works and MWSC with the US Geological Service.

These projects indicate that RMI is interested in mitigation opportunities, however, the recommendations offered from the Hazard Mitigation Survey Team from Tropical Storms Axel and Zelda, for the most part, reflect a “no action” status. Implementation of the recommendations require a commitment on the part of RMI to not only initiate the recommended projects, but to bring the projects through to fruition, thereby reducing Federal disaster dollars in the future.

1. 364th Civil Affairs Brigade, *Marshall Islands Disaster Preparedness Planning Survey*, Edited November 1991, pp. Disaster Response - 7

B. SUMMARY AND CONCLUSIONS

Tropical storms are RMI’s most frequently occurring hazard. Effective solutions to reduce vulnerability require a long-term commitment from RMI and Federal Agencies. Implementation, operation and maintenance of tropical storm related damage reduction activities and programs are primarily a RMI responsibility.

The Secretary of Public Works will ensure that the recommendations of the hazard mitigation survey and planning activities, and the mitigation strategies developed by RMI departments and agencies will be addressed, developed, and implemented according to a work program schedule. In addition,

the Secretary of Public Works will revise this plan as needed, and monitor implementation of mitigation proposals and projects. This plan includes initiatives that will protect people, structures and the environment from all natural and man-made hazards identified previously.

The Secretary of Public Works will develop hazard mitigation policies and strategies in co-ordination with participation from the Disaster Committee members.

SECTION 5 : HAZARD MITIGATION INITIATIVES

A. INITIATIVES - GENERAL STATEMENT

An estimated 48,000 Marshallese live in RMI. The inhabitants of these islands and atolls are at risk of not only losing their homes, but potentially their lives to future typhoons. Zoning and building standard issues are of increasing importance in Majuro and Ebeye, as these urban centers continue to experience intense population pressures.

A major mitigation opportunity lies with RMI agencies and local governments having genuine concerns with land-use and building standards. Education and subsequent support of the traditional landholders as to the positive, long-term benefits of planned development can solve a myriad of repetitive problems experienced disaster after disaster.

The local Councils must all be convinced that sound land management practices, which includes the implementation of zoning and building standards, is in their own and their people's best interests. Given the Council's veto authority on matters concerning traditional land rights, and the existing authority of each of the traditional landowners over their individual land and structures located thereon, it is imperative that these land owners be brought into the process of land planning.

The initiative outlined in this section represent an ambitious agenda requiring commitment, co-operation and participation of diverse organizations, agencies, and local councils. Progress on a number of initiatives will require action by both the President and the Disaster Council to establish policy assigning new responsibilities, granting new authority, appropriating additional fiscal resources and encouraging local councils.

The following initiatives address problems and concerns raised by previous disaster events. The initiatives are placed within the context of existing Republic and Federal hazard mitigation programs, local codes and ordinances (or the lack thereof), and current practices.

Mitigating opportunities must be outlined in this RMI Hazard Mitigation Plan before they can be considered for eligibility within the FEMA Hazard Mitigation Grant Program. Opportunities can be general in nature, as specific mitigation measures may not have been formulated at the time of this writing.

SUMMARY OF INITIATIVES

Category 1: Existing Vulnerable Facilities

- 1.1 Relocation and Acquisition (Principally major population areas)
- 1.2 Improve Safety of Homes
- 1.3 Harden Water Catchment Systems
- 1.4 Retrofit of Relocate Land Fill
- 1.5 Harden Power Plant
- 1.6 Hardening of Seawalls, Roads, Power Poles
- 1.7 Place Power Utility Lines Underground
- 1.8 Emergency Generators
- 1.9 Harden Hospital and Clinics
- 1.10 Upgrade and maintain causeways to improve exchange of water between lagoon and ocean

Category 2 : New Facilities

- 2.1 Review Construction Codes and Standards
- 2.2 Adoption of New Codes and Standards Develop Building Permit Process
- 2.3 Enforcement of New Codes and Standards
- 2.4 Building Inspection Training (if new codes are adopted)
- 2.5 Elevation of Structures
- 2.6 Portable sea water conversion units

Category 3 : Vegetation Management and Agriculture

- 3.1 Buffer Zones - Vegetation Management
- 3.2 Agricultural Nurseries of Seed Bank

Category 4 : Coastal Management Protection

- 4.1 Implementation of the Coastal Management Protection Plan
- 4.2 Subsistence Fisheries
- 4.3 Coastal Erosion - Majuro, Ebeye
- 4.4 Coral Reef Management

Category 5 : Environmental Management

- 5.1 Implement Water Quality Recommendations
- 5.2 Study and Implement Recommendations on Lagoon Pollution
- 5.3 Monitor Laura Water Lens
- 5.4 Recycling
- 5.5 Sewerage Facilities
- 5.6 Solid Waste Management

Category 6: Education and Training

- 6.1 Typhoon Resistant Subsistence Crop Agriculture and Land Management
- 6.2 Improve Typhoon/Tropical Storm Public Warning System
- 6.3 Public Education on How to Help Mitigate Hazards
- 6.4 Littering Enforcement and Public Information Campaigns

CATEGORY 1 : EXISTING VULNERABLE FACILITIES

Damage to the infrastructure and to the structural integrity of buildings is the most recognized and greatest threat to life safety and property during a typhoon or tropical storm. Existing buildings, lifelines and utility systems, especially those designed and constructed without the benefit of structural engineers, can be perceived as the source of many of RMI's hazards. Important strides must be made to reduce the hazards imposed on many of RMI's vulnerable facilities. The task of reducing this threat is not easy, nor inexpensive.

Initiative 1.1 Relocation and Acquisition (Principally major population areas)

In the event of major loss of structures in the major population areas by wind and water damage relocation and acquisition project could be developed and implemented. As a result, any property acquired, accepted, or from which a structure will be removed pursuant to the project must be dedicated and maintained in perpetuity for a use that is compatible with open space, recreational, or wetlands management practices. No new structure will be erected on property acquired, accepted or from which a structure was removed under the acquisition and relocation program.

- Lead Agency** : Ministry of Interior & Outer Islands Affairs
- Funding** : Hazard Mitigation Grant Program (up to 75% funding)
- Schedule** : Following future major disasters, where applicable
- Priority** : X Low, Medium, High

Initiative 1.2 Improve Safety of Homes

Construction codes presently in use in RMI routinely permit the construction of homes that will not stand up to tropical storms let alone typhoons. In general, homes are constructed with 2x3 wall studs and 1/2" plywood walls. In the future different, more typhoon resistant construction materials and techniques should be used, however, a mitigation strategy for the present building stock should be a retrofit program that could be developed and implemented to minimize the potential loss of property and to protect human life. This retrofit program could include such mitigation opportunities as elevation of structures and floodproofing.

- Lead Agency** : Ministry of Public Works
- Funding** : Hazard Mitigation Grant Program
- Schedule** : 1995
- Priority** : Low X Medium, High

Initiative 1.3 Harden Majuro Water Catchment System

The Majuro Water Catchment System entails 18 drain boxes installed in the airport runway to catch rainwater. The runoff is then pumped to five reservoirs each having a capacity of from three to five million gallons. The water is filtered and pumped into the distribution system. The distribution may be described as a single line system, in other words, more water is available closer to the course than at the end of the line.

The capacity of the catchment system was reduced by 40% as a result of Tropical Storm Axel and 50% as a result of the June, 1994 high surf event. The demand is well over 800,000 gallons per day. As a result of the repetitive damage to the catchment system during natural events the system should be studied for possible hardening techniques and recommendations should be implemented to minimize damage and incapacitation in the future.

- Lead Agency** : Public Works
- Funding** : Hazard mitigation
- Schedule** : 1995
- Priority** : Low, Medium, X High

Initiative 1.4 Retrofit or Relocate Major Landfills

Increasing population pressures and increasingly available non-biodegradable materials have exacerbated Majuro's and Ebeye's solid waster problems. Additional government attention to public landfills and community attention to littering problems are necessary. Communal land ownership systems require active landholder participation in any government initiated solid waste reduction proposals.

The two largest landfills in RMI are the Majuro and Ebeye disposal facilities. The Majuro facility has been in operation since 1989. Since then it has undergone two expansions. The disposal facility currently comprises 23,000 cubic yards along the oceanside of a long, narrow islet in central Majuro atoll. Buttressed by gabions along the ocean perimeter and fenced on the other three sides, the dump is neither lined nor adequately covered. Permit requirements of daily sand coverage, prohibitions on burning and restrictions on gabion placement are not enforced.

The Ebeye landfill is also inadequately maintained. Located near both lagoon and ocean waters, leaching is a real threat, and wind-tossed debris frequently finds its way into surrounding waters.

Lead Agency : Public Works/MALGOV
Funding : Hazard Mitigation
Schedule : 1995
Priority : Low, Medium, X High

Initiative 1.5 Harden Power Plant

The building housing the generators may be susceptible to damage from very high winds or of high waves thus endangering the equipment itself. That structure should be assessed accordingly.

Lead Agency : MEC
Funding : Hazard Mitigation
Schedule : 1995
Priority : Low, X Medium, High

Initiative 1.6 Hardening of Seawalls, Roads, Power Poles

The Republic of the Marshall Island's infrastructure often suffers repetitive damage due mostly to the impact of tropical storms, typhoons or high surf conditions. As a result, trade, transportation (both air and land), and utilities are often impeded for days to weeks following a disaster and the economic impact is incalculable. Recommendations regarding hardening of infrastructure should be developed and implemented if the repetitive damage is to be minimized in the future.

Lead Agency : Public Works
Funding : Existing Budgets, Hazard Mitigation Grant Program
Schedule : Early 1995
Priority : Low, Medium, High

Initiative 1.7 Place Power Utility Lines Underground

Majuro has approximately 35 miles of power lines, 22 miles of which are underground, with the remainder above ground and vulnerable to damage from typhoons and tropical storms. Wind displaced tin roof sheets and other flying debris routinely sever overhead power lines. Currently wooden poles are used for suspending the island's utility lines. There are no concrete poles in use and there are no plans to use them due to problems associated with their use, including : difficulty of repair or replacement; placement along narrow roads puts drivers at greater risk of serious injury or death; and difficulty of modification to accommodate new service. Placing utilities underground improves stability and is much cheaper to maintain than overhead lines.

Lead Agency : Marshall Islands Development Authority, Marshall Islands Energy Company
Funding : To be determined
Schedule : 1995
Priority : Low, Medium, X High

Initiative 1.8 Emergency Generators - Water, Salt Water & Sewer Systems

Majuro has pumping facilities in 14 locations located through out the atoll. When electrical power service is interrupted all of the pumps at these facilities go down. Consequently there is a total disruption of water service, except for those facilities having individual reserves which can be operated manually. The salt water supply system becomes inoperable leaving virtually all of the DUD area without the means to flush toilets. The sewer system also fails resulting in potential sewerage overflow at each pump station (7) and backup in houses. An emergency power scheme wherein generators are located at all or some (depending on interconnect ability) of the pump stations in "Hardened" condition is a solution.

Lead Agency : MCE
Funding : Hazard Mitigation
Schedule : 1995
Priority : Low, Medium, X High

Initiative 1.9 Harden the Hospital

The hospital and clinic facilities are vital operations especially in the aftermath of a major disaster where injuries to the inhabitants of RMI occur. As such those facilities should be assessed as to their structural integrity and their general state of operational readiness when it comes to being able to survive a major disaster and thereafter to provide medical care. Should they be found deficient, a program should be established and then funded to provide for making the facilities more "survivable".

Lead Agency : Public Works
Funding : Hazard Mitigation
Schedule : First October of 1995
Priority : Low, Medium X High

Initiative 1.0 Upgrade and Maintain Causeways to Improve Exchange of Water Between Lagoon and Ocean (Flushing)

It has been noted in a number of studies that the filled causeways which link a dozen islands on Majuro by paved road, encircling nearly two-thirds of the lagoon has caused irreversible coastal erosion. Comparable studies at other atolls outside the Marshall have confirmed that the virtual collapse of lagoonal ecosystems is imminent following the enclosure of lagoon by similar filled causeways. By preventing the natural dispersion of storm surges, the existing causeways augment still water rise on the ocean-side, magnifying storm flooding of urban Majuro. By diverting coastal currents from their natural paths, the causeways may be contributing to the erosion of coastal areas. Culverts and bridges may require higher capital, however, it may prove to be the remedy in the future to eliminate future environmental losses.

The causeway nearing completion from Ebeye to Guegeegue on Kwajalein Atoll may severely exacerbate an already dramatic pollution problem at this atoll. It may prevent the exit of the sewage from Ebeye, compromising an already diminished lagoonal water quality and coral reef health. A formal study of the ecosystem should be undertaken and recommendations implemented.

It has also been noted that KADA has the responsibility of developing and overseeing construction of the Ebeye causeway, however, upon completion the project will be turned over the KALGOV to maintain. Funds have not been identified for this task.

Lead Agency : Public Work/KALGOV
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, X Medium, High

CATEGORY 2 : NEW FACILITIES

Current construction techniques on RMI do not hold up to strong winds. Debris from poor, inadequate, or unsuitable construction often becomes airborne projectiles that can cause personal injury as well as damage to other structures. The use of concrete block, brick or pre-fabricated concrete walls as required construction materials, or similar wind resistant construction, should be researched, and encouraged by regulation, building ordinance or other legislation. Concrete houses are new to the Pacific Islands, however, this type of construction material along with other alternatives such as the use of construction techniques (load bearing walls and engineered structures) can reduce the potential for catastrophic damage and personal injury in the case of tropical storms and high surf or other hazards.

Initiatives 2.1 Review Construction Codes and Standards

With continued population migration to the major atolls, current and future planning efforts become critical. Implementation of planning measures assumes even greater significance as demands for services, shelter, and subsistence exceed RMI's resources.

The Planning and Zoning Act of 1987 should be implemented to include the establishment of a Chief Planner at the national government level and installing Planning Commissions and Physical Planners at the local government level.

Planning Commissions should be established in each local government Council, especially the heavily urbanized areas, to assess the need for formal zoning and building requirements. If a need is established, the National Government Chief Planner would be able to offer technical assistance for the development of appropriate guidelines.

As an example, the Jaluit Atoll Local Council enacted Ordinance No. 1998-01, the Jabor Ward Zoning Ordinance. This ordinance was promulgated to promote the "...orderly and economic development of Jabor by providing a framework through which the best possible patterns of land use may be promoted, consistent with the health, safety and general welfare of the people."

The status of private landowners serving on Planning Commissions would need to be clarified.

Lead Agency : Office of the Chief Secretary

Funding : FEMA (Hazard Mitigation Grant Program or Disaster Preparedness Improvement Grant, 1992-93 CCA), to develop zoning and building requirements that will contribute directly to the reduction of future damages and potential loss of life

Schedule : 1995

Priority : Low, X Medium, High

Initiative 2.2 Adoption of New Codes and Standards: Develop Building Permit Process

Typhoon-Resistant Building Codes and Standards should be adopted. A building permit process and enforcement mechanism should be established.

It is generally agreed that the formulation and implementation of typhoon-resistant building standards is necessary and overdue. The lack of these standards for the Republic of Marshall Islands has promoted and prolonged unnecessary threats from natural disasters such as Tropical Storms Axel and Zelda. Nevertheless, mechanisms exist which can facilitate recommendations to the Cabinet for essential changes, additions to, or the creation of zoning, building and other land use controls.

The building standards must be negotiated with the high cost of materials, and the absence of low cost financing, in mind. It must be realized that all building problems cannot be solved in the name of implementing these typhoon-resistant standards. The standards should be usable by local builders and inspectors without the aid of a licensed engineer or architect.

Lead Agency : Ministry of Public Works, Office of Planning and Statistics, Local Governments

Funding : Existing budgets, Hazard Mitigation Grant Program, Disaster Preparedness Improvement Grant

Schedule : FY1995

Priority : Low, Medium, X High

Initiative 2.4 Building Inspection Training

If new codes and standards are adopted, a training program should be developed and implemented to train building inspectors.

Lead Agency : Public Works
Funding : Normal Operating Budgets, Hazard Mitigation Grant
Schedule : 1995/6
Priority : Low, Medium, X High

Initiative 2.5 Elevation of Structures

Coastal flooding is generally due to severe ocean based storm systems. Typhoons, tropical storms are the principal causes, with flooding occurring when storm tides are higher than normal high tides, and are accompanied by water moving at relatively high velocity and velocity wave action. The maximum damage potential of a storm surge occurs at high tides, therefore storms that persist through several tides are the most severe. As a result, RMI should consider elevation of structures using post and piles construction methods as a viable mitigation measure.

This technique allows water to flow beneath the structure unimpeded which reduces the damage suffered by the effects of the high velocity water flows.

Lead Agency : Public Works
Funding : Hazard Mitigation
Schedule : 1995
Priority : Low, X Medium, High

Initiative 2.6 Portable Seawater Conversion Units

Major storm, fire, or wave/wind caused damage or drought can seriously adversely affect water supplies and quality (i.e. seawater contamination) not only in the major population centers but in the outer islands also when individual catchments are destroyed. In those events, fully self contained portable desalination units could be dispersed to provide for at least minimal drinking and personal sanitation needs at selected pre determined locations. The program would be to identify the number and size of desalination units necessary, then to purchase the units, then to site them and provide for maintenance and routine operation so that they are fully operational when needed.

Lead Agency : Public Works
Funding : Hazard Mitigation
Schedule : 1995/6
Priority : Low X Medium High

CATEGORY 3 : VEGETATION MANAGEMENT AND AGRICULTURE

The damage estimations of crop and vegetation losses do not adequately reflect long term losses to productivity and the effects of salt spray, salt water and high winds. All sources of food and water can be destroyed or contaminated by salt water or salt spray. As a result islands and atolls may be totally dependent on outside aid and remain so until local crops are replanted and harvested. The regeneration period can range from six months to five years. Salt resistant crops and ocean barrier broadleaf vegetation management may minimize the effects of salt and winds.

Initiative 3.1 Buffer Zones - Vegetation Management

The damage often incurred as a result of tropical storms or typhoons comprises impacts of wind to structures, direct inundation of low-lying areas including structures built on grade level, wind damage to food trees, and damage to food and utility trees caused by wind driven salt spray.

A major portion of the damage is due to exposure to salt spray generated at the breaker zone and driven inland by the high velocity winds. The main reason for the increased impact of salt spray is the destruction of the natural salt spray barrier formed by the ocean shore vegetation which includes saltwater bush and pandanus. In an undisturbed situation these hardy and salt resistant plants filter out most of the salt and humidity in the air.

The physical development, coupled with the extraordinary population increase on Majuro Atoll in particular, has seen the departure from the traditional settlement patterns. Over time the settlement area has extended from the protected lagoonal shore to the ocean shore. This trend is continuing with homes being erected closer and closer to the shoreline which creates a very vulnerable situation during times of wind-generated wave action.

The traditional methods of land management have been forgotten and the land is increasingly modified to suit individual short-term needs. The result is the fact that few, if any plants are being replaced to improve the immediate environment. Since these barrier plants have little commercial value, there is no perceived need to replant them. As a result a vegetation management program must be developed and implemented to protect the environment, housing stock and crops from salt spray damage.

The benefit apart from protection against the climatic extremes of tropical storms and typhoons is the salt spray filter benefits the house owners experience as it cuts down on salt levels in the air, thereby prolonging the life of electrical appliances including outside mounted air conditioners.

If pandanus is replanted, a side benefit is the fruit these plants produce, providing additional nutrition to the population. Pandanus fruit contains the highest natural Vitamin A content among the fruit family, which is often noted as deficiency among the community, especially young children.

Lead Agency : Ministry of R & D
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, Medium , X High

Initiative 3.2 Agricultural Nurseries or Seed Bank

A subsistence agriculture project for the Republic of the Marshall Islands could be incorporated with those performed in the Federated States of Micronesia and the Republic of Palau. Prototypes ongoing in the Yap and Palau could be adopted and honed by RMI in an effort to greatly lessen dependence (particularly the outer islands and atolls) on foreign food supplements following major disasters, and would represent a significant step in assuring self-sufficiency of land based resources.

Prolonged dependence on western food supplements is detrimental to the indigenous island populations. This land based agriculture project would provide an opportunity to reverse or at least halt the increasing dependence of isolated communities upon self-defeating and expensive food assistance programs following natural disasters. This project in concert with subsistence fishing represents the first significant step toward a return to self-sufficiency in marine and land based food resources.

The development and maintenance of a seed bank of native foods (taro, breadfruit,...) for use throughout RMI and acquiring new species of plants that are being developed as more resistant to salt spray and the effects of natural disasters would be the basis for the project.

There is an active subsistence crop program proposal. One of the primary objectives of this proposal is to provide for future emergency needs, and to limit the necessity for massive emergency food assistance.

Lead Agency : Ministry of R & D
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, Medium, X High

CATEGORY 4 : COASTAL MANAGEMENT PROTECTION

Initiative 4.1 Implementation of the Coastal Management Protection Plan

Public Law 1988-13, the Coast Conservation Act of September 21, 1988, charges the Director of Coast Conservation to, as soon as practicable, complete a survey of the Coastal Zone, and based on its findings, submit a Coastal Zone Management Plan to the Environmental Advisory Council by September 21, 1991.

The Management Plan is crucial to the implementation of the Coast Conservation Act and to the necessary regulations to give effect to any of the provisions of the Plan.

Lead Agency : Environmental Protection Authority, Ministry of Interior and Outer Island Affairs, Local City Councils
Funding : Existing agency budget, Hazard Mitigation Grant Program
Schedule : Early 1995
Priority : Low, Medium, X High

Initiative 4.2 Subsistence Fisheries

A subsistence fisheries project in the Republic of the Marshall Islands could be incorporated with those performed in the Federated States of Micronesia and the Republic of Palau. Prototypes ongoing in the FSM could be adopted by RMI in an effort to greatly lessen these island's dependence (particularly the outer islands and atolls) on foreign food supplements following major disasters, and would represent a significant step in assuring self-sufficiency of marine based resources.

This project in concert with subsistence agriculture represents the first significant step toward a return to self-sufficiency in marine and land based food resources.

Lead Agency : MIMRA
Funding : Hazard Mitigation Grant Program
Schedule : 1995/1996
Priority : Low, X Medium, High

Initiative 4.3 Coastal Erosion - Majuro, Ebeye

Dredging, sand mining, development of the coastal zone, and the construction of inter-island causeways all contribute to coastal erosion. Illicit removal of sand from beaches is commonplace. Such uncontrolled sand mining enhances coastal erosion.

Development of the coastal zone is also largely uncontrolled. The extremely high population densities of Majuro and Ebeye, and the rapid rate of growth of the population has resulted in a proliferation of unmonitored coastal zone construction over the past five years. The absence or lack of enforcement of a comprehensive Coastal Zone Management Plan further exacerbates the situation.

Lead Agency : EPA
Funding : Current Budget, Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, X Medium, High

Initiative 4.4 Coral Reef Management

Ongoing destruction of coral reefs represents a serious environmental challenge. Living reefs are essential wave breakers which help avert coastal erosion and storm flooding, and are suppliers of organic matter which build up the atolls. Such activities as dredging, channel blasting and boat anchoring are particularly destructive to the coral reefs.

Primarily on Majuro and Kwajalein, sand and gravel for construction is extracted from the lagoonal intertidal and nearshore zones by suction and bucket dredging. The large volume of sand displaced during suction dredging is carried down current where it is deposited on the reefs leading to gradual, irreversible reef death.

Channel passages into the lagoons of many atolls have been widened and deepened to accommodate the government Micro-class field trip ships servicing the outer atolls. By definition, the dynamic blasting and dredging performed to create these channels and passages must destroy reef systems. Some methods are more destructive than others.

Lead Agency : EPA
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, X Medium, High

CATEGORY 5 : ENVIRONMENTAL MANAGEMENT

Initiative 5.1 Implement Water Quality Recommendations

Implement water quality recommendations as outlined in the December 1991 draft document "Strengthening Environment Management Capabilities in Pacific Island Developing Countries" by the RMI Environmental Protection Authority's Regional Environment Technical Assistance (RETA) Project, in partial fulfilment of its National Environment Management Strategy.

The draft recommendations address needed improvements in water quality monitoring, fresh water and groundwater protections, point source marine discharge regulation, fresh water collection, and handling of PCB wastes.

There exists increasing shortages of safe, portable water in the RMI. Majuro’s municipal water catchment system, consisting of airport runway water catchment and tapping of subsurface lenses, are strained to capacity. Development of alternate water sources such as private wells and rain water catchment systems is imperative. Contamination is an ongoing problem and there exist a variety of potential sources. Shortages and contamination are accentuated by typhoons/tropical storms as witnessed immediately after Tropical Storm Axel.

There has been virtually no development of alternative water sources, though protection from storm and high surf action of the airport catchment system with upright barriers has been approved by the US Federal Aviation Administration. However, since the high surf of June 9 & 10, 1994, the catchment systems have remained 50% off-line. In addition, water quality monitoring by RMI EPA has increased to monitor contamination, but is largely inadequate due to staff shortages.

Lead Agency : Environmental Protection Authority, Ministry of Public Works, Majuro Water and Sewer Company

Funding : Existing budgets, Hazard Mitigation Grant Program

Schedule : 1995

Priority : Low, Medium, X High

Initiative 5.2 Study and Implement Recommendations on Lagoon Pollution

With the lack of a waste water or sewage treatment plant in RMI the outfall pipe discharges raw sewage directly into the lagoon in Ebeye and into the ocean in Majuro. This along with general littering problems creates an ongoing environmental problem for RMI. A study and implementation of recommendations may be the first step in minimizing lagoon pollution in the future.

Lead Agency : Ministry of Public Works

Funding : Hazard Mitigation Grant Program

Schedule : 1995

Priority : Low, Medium, X High

Initiative 5.3 Monitor Laura Water Lens

Ensure that the Laura Fresh Water Lens is properly monitored as to the effects of the present ground-water development plan.

The recent development of the Laura Fresh Water Lens presents a unique opportunity to monitor the response of this freshwater lens to sustained pumping, and will provide the essential information for sound management of this valuable resource. In addition, this information will be invaluable for the future development of atoll freshwater lenses throughout the Marshall Islands as well as the Pacific and Indian Oceans.

Successful management of the Laura Lens requires trained personnel who are able to understand the relationship between well production, recharge to the lens, and the condition of the freshwater nucleus. The US Geological Survey Water Resources Division has proposed a monitoring program for the Laura Lens. A Majuro Environmental Health Department employee would be

trained in the collection of these data. The collected data would be sent to the US Geological Survey in Hawaii for review and analysis.

The data collected during the monitoring program would enable Majuro water resource managers (Pacific Management Services Corporation) to detect changes in water quality, to correlate pumpage to lens condition, and to continuously evaluate estimates of sustained yield.

There has been renewed interest in this project with support from the Asian Development Bank. The status to date is monitoring devices installed are minimal and need to be supplemented.

Lead Agency : Majuro Water and Sewer Company, Majuro Environmental Health Department, US Geological Survey, Water Resources Division

Funding : 50% USGS, and 50% RMI

Schedule : 1995

Priority : Low, Medium, X High

Initiative 5.4 Recycling - Majuro, Ebeye

Rapid population growth and lack of recycling have contributed to the increase in solid waste generation. The current rate of fill development has reached 0.985 acres per year on Majuro. The life of the landfill could be significantly extended through recycling.

Lead Agency : MALGOV/KALGOV

Funding : Hazard Mitigation Grant Program

Schedule : 1996

Priority : X Low, Medium, High

Initiative 5.5 Sewerage Facilities

On both Ebeye and Majuro, much of the sewerage systems are old and in need of repair.

On Ebeye, raw sewerage is being pumped into the lagoon because of the settling pond and aerators are inoperable. This becomes a hazard not only to marine life but to fishermen, children and ultimately the general population. Diffusers have been removed to allow clogged openings to flow freely which has permitted even more sewerage to reach the surface and adjacent beaches. At times restricted flow in the outfall results in overflow of effluent from the settling ponds to the surrounding residential areas creating health hazards to the families living in the area.

Since stormwater and sand filter drains are not well maintained, large areas of roads and sidewalks are covered with water for days during the rainy season. Children play in these standing pools and as a result many faecal-oral infections can be contracted through this standing waters. Lack of enforcement of anti-littering laws have also contributed to the drainage problem.

On Majuro the highly corrosive environmental conditions and inappropriate equipment for such conditions have resulted in many system failures. Cross-connections and system leaks are numerous. Faecal coliforms and high levels of chloride are frequently found in the distribution system during the dry season when long periods of negative pressure allow the intrusion of polluted water.

Lead Agency : Public Works/KALGOV
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, Medium, X High

Initiative 5.6 Solid Waste Management

Solid waste management remains one of the primary environmental issues in the nation, ground litter and marine debris being virtually ubiquitous.

A formal program of hazardous waster management needs to be developed and implemented to include public education. The build-up of terrestrial and marine solid waster has a multitude of negative environmental impacts, including the destruction of marine organisms, the spread of vector-borne disease, and the contamination of fresh water resources. Since there is no segregation of potentially hazardous materials such as empty pesticide containers, florescent lights, chemicals, paints, cadmium batteries, or even the detoxification of cars, heavy equipment etc. the potential for hazardous leached production is high and poses a serious threat to the marine environment both on Majuro and Ebeye.

It appears that collection of solid waster in Majuro is erratic, contributing to public health and pollution problems. In frustration, some residents have reverted to the traditional practice of throwing household waste into the ocean or lagoon. When the solid waste is collected, it is taken to the public landfill located on the ocean side of the atoll in Majuro and the lagoon side of the atoll in Ebeye. In Majuro, plastic coated wire cages, known as gabions (estimated life of five years) are filled with coral rubble and used to build a partial sea wall before waste is dumped. In Ebeye, trash collection is rather reliable, however at high tide, the trash is carried freely into the lagoon from the dump site.

Lead Agency : EPA
Funding : Hazard Mitigation Grant Program
Schedule : 1996
Priority : X Low, Medium, High

CATEGORY 6 : EDUCATION AND TRAINING

Initiative 6.1 Typhoon Resistant Subsistence Crop: Agriculture and Land Management

A public education program should be developed, or continued, which disseminates information about traditional typhoon-resistant subsistence crop in agriculture and land management techniques.

Subsistence crops, such as banana, breadfruit, papaya, pumpkins, pandanus and other vegetable and fruit crops suffered major damage during Tropical Storm Axel due to high winds and/or saltwater spray blown from typhoons. This was caused by two factors: 1) the destruction of the naturally occurring broadleaf forest along the shoreline which served as a salt spray barrier; and 2) the planting of crops in areas which are highly vulnerable to salt spray.

Lead Agency : Ministry of Resources and Development, Historical Preservation Office
Funding : Disaster Preparedness Improvement Grant, Hazard Mitigation Grant Program

Schedule : 1995
Priority : Low, Medium, X High

Initiative 6.2 Improve Typhoon/Tropical Storm Public Warning System

Public information (advance warning) about Tropical Storm Axel was apparently inadequate. Operational procedures for typhoon/tropical storm warning, as currently outlined in the RMI Disaster Plan, require the weather service to pass weather warning directly to the Chief Secretary (or Deputy), not to the media. Standard operating procedures should dictate that as timely storm warnings are issued by the Joint Typhoon Warning Center in Guam, they should be passed directly to the public on a regular and frequent basis. Change is necessary in the current policy of controlling and restricting access to public information with regard to weather warnings.

Lead Agency : Disaster Committee, Division of Public Information and Broadcasting, Ministry of Interior and Outer Island Affairs
Funding : Disaster Preparedness Improvement Grant
Schedule : 1995
Priority : Low, Medium, X High

Initiative 6.3 Littering Enforcement and Public Information Campaigns

Currently RMI litter prohibitions exist at three levels (local ordinance, national act, and RMIEPA subsidiary solid waste regulations) however, no organization takes the lead in enforcement. RMI should provide for better litter enforcement. Enforcement must be coupled with vigorous public information campaigns on the environmental and public risk associated with inadequate solid and liquid waste disposal.

Lead Agency : Public Safety
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, Medium, X High

Initiative 6.4 Public Education on how to Help Mitigate Hazards

Goal is to provide basic information to all RMI citizens as to what each of them as private citizen can do to help mitigate hazards associated with their living quarters, ancillary buildings, vehicles etc... Brochures would contain information on what individual homeowners can do i.e. turn off the electrical power at the switch box, close the water and salt water shut off valves etc... On going, periodic educational announcements on radio and TV, and educational notices sent with MEC, MWSC and NTA bills is another way of education.

Lead Agency : Education
Funding : Hazard Mitigation Grant Program
Schedule : 1995
Priority : Low, X Medium, High

SECTION 6 : PLAN MAINTENANCE AND IMPLEMENTATION

This plan will be evaluated on an annual basis or directly, following any declared disaster to ensure that implementation occurs as planned and the Plan remains current.

A. Maintenance

Plan maintenance involves:

1. Co-ordination and implementation of hazard mitigation recommendations
2. Monitoring implementation progress and any changes, positive or negative, in the vulnerability analysis
3. Evaluation of success or failure of each effort; and
4. Updating the RMI Hazard Mitigation Plan to reflect the above factors.

B. Implementation

Implementation will be co-ordinated by the Secretary of Public Works with the support, technical assistance, and advice of the Federal Emergency Management Agency Hazard Mitigation Officer. Co-ordination will be in conjunction with those local government officials who are responsible for implementing specific projects. The RMI Hazard Mitigation Grant Program Administrative Plan outlines procedures to be followed in administering the Hazard Mitigation Grant Program.

C. Monitoring

The Secretary of Public Works will be responsible for maintaining quarterly progress reports of ongoing projects to FEMA as required.

D. Evaluation

Upon a Presidential disaster declaration, RMI will be required to update the RMI Hazard Mitigation Plan. Evaluation and updating may include:

1. Developing new hazard mitigation recommendations and/or issues;
2. Reprioritizing existing mitigation actions;
3. Expanding the Plan to address additional hazards; and
4. Determining if there are policies, programs and capabilities to address the hazards and reduce future vulnerability.

APPENDICES

Appendix A

Definition of Terms

Disaster (RMI definition) - The occurrence or imminent threat of widespread or severe damage, injury or loss of life or property resulting from any natural or man-made cause, including but not limited to fire, flood, earthquake, wind, storm, wave action, oil spill or other water contamination, requiring emergency action to avert danger or damage, volcanic activity, epidemic, air contamination, blight, drought, infestation, explosion or civil disturbances.

Disaster Preparedness Improvement Grant - Program authorized under Section 201 of the Stafford Act. Annual matching awards not to exceed \$50,000 are provided to states to improve or update their disaster assistance plans and capabilities.

Emergency - Any typhoon, tornado, storm, flood, high-water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mud-flow, drought, fire, explosion or other catastrophe in any part of the Republic of the Marshall Islands which requires Federal emergency assistance from the United States Government to supplement National Government efforts to save lives and protect public health and safety to avert or lessen the threat of a major disaster.

Emergency Management - The provision of overall operational control and/or co-ordination at each level of the RMI emergency management organization.

Emergency or Disaster Plans - Those official and approved documents which describe principles, policies, concepts of operations, methods and procedures to be applied in carrying out emergency operations or rendering mutual aid during emergencies. The plans include such elements as continuity of government, emergency functions of governmental agencies, mobilization and application of resources, mutual aid, and public information.

Federal Hazard Mitigation Officer - the FEMA employee responsible for representing the agency for each declaration in carrying out the overall responsibilities for hazard mitigation.

FEMA-RMI Agreement - states the understanding, commitments and conditions for assistance under which FEMA disaster assistance shall be provided. This agreement imposes binding obligations on FEMA and RMI in the form of conditions for assistance which are legally enforceable.

Hazard Mitigation - Any action to reduce repetitive loss, the effects of the hazard or vulnerability to the hazard; and contributes to long term solutions.

Hazard Mitigation Grant Program - authorized under Section 404 of the Stafford Act. Provides funding for hazard mitigation projects that are cost effective and complement existing post-disaster mitigation programs and activities by providing funding for beneficial mitigation measures that are not funded through other programs.

Hazard Mitigation Administrative Plan - the Plan developed by the RMI to describe the procedures for administration of the Hazard Mitigation Grant Program.

Hazard Mitigation Plan - the hazard mitigation plan required under Section 409 as a condition of receiving Federal disaster assistance.

Hazard Mitigation Survey Team or Interagency Hazard Mitigation Team - the FEMA/RMI survey team that is activated following disasters to identify immediate mitigation opportunities and issues to be addressed in the Section 409 Hazard Mitigation Plan.

Individual Assistance Human Services - supplementary Federal assistance provided in the Stafford Act to individuals and families adversely affected by a major disaster or emergency.

Major Disaster - Any typhoon, tornado, storm, flood, high-water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, drought, fire, explosion or other catastrophe in any part of the Republic of the Marshall Islands, which, in the determination of the President of the United States, causes damage of sufficient severity and magnitude to warrant major disaster assistance under the Federal Disaster Relief Act to supplement the efforts and available resources of RMI, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.

Pacific Area Office - The FEMA IX Pacific Area Office is the initial point-of-contact for information regarding FEMA for the RMI government. They can be reached at 808 851-7900.

Political Subdivision - Any atoll or island on which a system of local government operates.

Public Assistance (Infrastructure) - Federal financial assistance provided to RMI and local governments or to eligible private non-profit organizations for disaster-related requirements.

RMI Hazard Mitigation Officer - the representative of the RMI government who serves on the Hazard Mitigation Survey Team or Interagency Hazard Mitigation Team and who is the primary point of contact with FEMA, other Federal agencies, and RMI Departments and Agencies in the planning and implementation of post-disaster mitigation activities.

Section 404 - of the Stafford Act, authorizes the Hazard Mitigation Grant Program which provides funding for cost-effective hazard mitigation measures.

Section 409 - of the Stafford Act, enacted to encourage identification and mitigation of hazards at all levels of government. Section 409 requires the identification and evaluation of mitigation opportunities as a condition for receiving Federal disaster assistance.

Stafford Act - Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23rd, 1988; amended the Disaster Relief Act of 1974, PL 93-288.

Appendix B

Recommendations

The following recommendations have been taken verbatim from the Hazard Mitigation Survey Team Reports.

TROPICAL STORM ZELDA (FEMA-925-DR-MH)

Recommendation 1: Cut off power to homes where service drops have been re-established in an unsafe manner to remove immediate threat of fire. Rewire service drops using appropriate wire size, circuit breakers and/or fuse boxes before service is restored.

Recommendation 2: Place power utility lines underground.

Recommendation 3: Develop Typhoon-Resistant Building Standards and establish a building permit process and enforcement mechanism.

Recommendation 4: Develop a public education program which disseminates information about traditional typhoon-resistant subsistence crop agriculture and land management techniques.

Recommendation 5: Improve typhoon/tropical storm public warning system. Revise operational procedures as described in the Marshall Islands Disaster Plan. Conduct training exercises a minimum of once a year as specified in the Plan. Include media in exercises.

Recommendation 6: Implement the Planning and Zoning Act of 1987 to include the establishment of a Physical Planning Office at the national government level and installing Planning Commissions and Physical Planners at the local government level.

Recommendation 7: Complete the Comprehensive Coastal Zone Management Plan.

Recommendation 8: Implement water quality recommendations as outlined in the December 1991 draft document "Strengthening Environment Management Capabilities in Pacific Island Developing Countries", by the RMI Environmental Protection Authority's Regional Environment Technical Assistance (RETA) Project, in partial fulfillment of its National Environment Management Strategy.

Recommendation 9: Ensure that the Laura Fresh Water Lens is properly monitored as to the effects of the present ground-water development plan.

TROPICAL STORM GAY (FEMA-971-Dr-MH)

In reference to Tropical Storm Gay (FEMA-971-DR-MH), recommendations were not formulated following this disaster declaration. Research efforts were concentrated on tracking the effects of previous recommendations for Tropical Storms Axel and Zelda. The result of this research has been annotated as part of the Supporting Statement following each recommendation.

HIGH SURF EVALUATION (June 9 and 10, 1994)

On June 9 and 10, 1994 high surf compounded by high tides ravaged to Majuro Atoll. This event was largely unpredicted, and though not a rare phenomena, it rarely impacts the Pacific Islands. The major damage attributed to the high surf included severe damage to the airport seawall, long-term damage to 30% of the airport water catchment system, significant debris, the landfill (build on the ocean side of the atoll), housing and roads.